CLAIMS

What is claimed is:

1. A method for converting a three-color image data set comprising C1, C2, and C3 colors into a four-color image data set comprising C1, C2, C3 and W colors, the method comprising:

dividing said color space comprising a C1, C2, C3, and W color point into a set of regions bounded by W and two of a group, said group comprising: C1, C2 and C3; and

determining a mapping from image data points in any one of said regions, said image data points comprising C1, C2 and C3 color values, to image data points comprising C1, C2, C3, and W.

2. The method of Claim 1 wherein the three colors C1, C2, and C3 comprise R, G and B.

3. The method of Claim 1 wherein the regions bounded by W and two of a group, said group comprising C1, C2 and C3 comprises triangles.

4. The method of Claim 1 wherein step of determining a mapping further comprises:

setting the white point in the four-color space to a desired value; and

calculating intermediate coefficients for the four colors using the desired white point.

5. The method of Claim 4 wherein said step of calculating the coefficients further comprises solving the following matrix equation for the values Cr Cg Cb and Cw:

$$
\begin{pmatrix} X_w \\ Y_w \\ Z_w \end{pmatrix} = \begin{pmatrix} x_r & x_g & x_b & x_w \\ y_r & y_g & y_b & y_w \\ z_r & z_g & z_b & z_w \end{pmatrix} \cdot \begin{pmatrix} Cr \\ Cg \\ Cb \\ Cw \end{pmatrix}
$$

6.   The method of Claim 4 wherein setting the white point further comprises setting the white point to adjust to different backlighting condition for target displays.

7.   The method of Claim 4 wherein setting the white point further comprises setting the white point to adjust between difference between the white point of the source image data and the white point of the target display.

8.   The method of Claim 4 wherein the step of determining a mapping further comprises:

calculating the mapping to four color space from said intermediate coefficients with the following matrix:

$$\begin{pmatrix} R \\ G \\ B \\ W \end{pmatrix} = \begin{pmatrix} R1 & R2 & R3 \\ G1 & G2 & G3 \\ B1 & B2 & B3 \\ W1 & W2 & W3 \end{pmatrix} \cdot \begin{pmatrix} X \\ Y \\ Z \end{pmatrix}$$

9.   The method of Claim 8 wherein calculating the mapping to four color space further comprises calculating source and destination colors for groups of known primaries and whitepoints, and numerically solving for the mapping that produce said known primaries.

10.   The method of Claim 1 wherein said method further comprises:

detecting four color image data points that are out-of-gamut;

effecting a change in only the out-of-gamut cofficients to produce a color image data point that is within gamut range.

11.   The method of Claim 10 wherein said step of detecting out-of-gamut color image data points further comprises:

testing each color component of the image data point to see if the color component is out of range.

12.   The method of Claim 11 wherein the step of effecting a change in only the out-of-gamut coefficients further comprises:

clamping the out-of-range color components to the maximum value allowed for th given component.

13.   The method of Claim 11 wherein the step of effecting a change in only the out-of-gamut coefficients further comprises:

scaling the color components of the out-of-gamut image data point with a ratio between the maximum allowed value and the maximum coefficients of the out-of-gamut image data point.

14.   A system for calculating a scaling factor for out-of-gamut image data points comprising:

an input channel to receive image data points;

a maximum coefficient detector;

an inverse look-up table, said table storing said scaling factors;

a scaling unit, said unit changing the coefficients of said image data points to effect an in-gamut image data point.

15.   An image system comprising:

a display for displaying a three-color image data set comprising C1, C2, and C3 colors converted into a four-color image data set comprising C1, C2, C3 and W colors; and

processing circuitry to divide said color space comprising a C1, C2, C3, and W color point into a set of regions bounded by W and two of a group, said group comprising: C1, C2 and C3 and to determine a mapping from image data points in any one of said regions, said image data points comprising C1, C2 and C3 color values, to image data points comprising C1, C2, C3, and W.

16.   The image processing system of Claim 15 wherein the three colors C1, C2, and C3 comprise R, G and B.

17.   The image processing system of Claim 15 wherein the regions bounded by W and two of a group, said group comprising C1, C2 and C3 comprises triangles.

18.   The image processing system of Claim 15 wherein the processing circuitry is to set the white point in the four-color space to a desired value and calculate intermediate coefficients for the four colors using the desired white point.

19.   The image processing system of Claim 15 wherein the processing circuitry is to calculate coefficients using the following matrix equation for the values Cr Cg Cb and Cw:

$$\begin{pmatrix} X_w \\ Y_w \\ Z_w \end{pmatrix} = \begin{pmatrix} x_r & x_g & x_b & x_w \\ y_r & y_g & y_b & y_w \\ z_r & z_g & z_b & z_w \end{pmatrix} \cdot \begin{pmatrix} Cr \\ Cg \\ Cb \\ Cw \end{pmatrix}$$

20.   The image processing system of Claim 19 wherein the processing circuitry is to set the white point to adjust to different backlighting condition for target displays.

21.   The image processing system of Claim 19 wherein the processing circuitry is to set the white point to adjust between difference between the white point of the source image data and the white point of the target display.

22.   The image processing system of Claim 21 wherein the processing circuitry is to calculate he mapping to four color space from said intermediate coefficients with the following matrix:

$$\begin{pmatrix} R \\ G \\ B \\ W \end{pmatrix} = \begin{pmatrix} R1 & R2 & R3 \\ G1 & G2 & G3 \\ B1 & B2 & B3 \\ W1 & W2 & W3 \end{pmatrix} \cdot \begin{pmatrix} X \\ Y \\ Z \end{pmatrix}$$

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23. The image processing system of Claim 15 wherein the processing circuitry is to detect four color image data points that are out-of-gamut and effect a change in only the out-of-gamut cofficients to produce a color image data point that is within gamut range.

24. The image processing system of Claim 23 wherein the processing circuitry is to test each color component of the image data point to see if the color component is out of range.

25. The image processing system of Claim 24 wherein the processing circuitry is to clamp the out-of-range color components to the maximum value allowed for the given component.

26. The image processing system of Claim 25 wherein the processing circuitry is scale the color components of the out-of-gamut image data point with a ratio between the maximum allowed value and the maximum coefficients of the out-of-gamut image data point.